

R E P O R T

REMEDIAL ACTION COMPLETION REPORT

1020 DIXIE HIGHWAY CHICAGO HEIGHTS, ILLINOIS

Prepared for
City of Chicago Heights
1601 Chicago Road
Chicago Heights, Illinois 60411

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Project # 25366211.40000

Remedial Action Completion Report – Former Bloom Plaza

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LIST OF ABBREVIATIONS

BR	Bouwer and Rice
CBP	Cooper, Bredehoeft, Papadopoulos
cm/s	centimeter per second
COC	Chain of Custody
DCE	cis-1,2-Dichloroethene
EDR	Environmental Data Resources
ELUC	Environmental Land Use Control
ESA	Environmental Site Assessment
HAA	Highway Authority Agreement
HASP	Health and Safety Plan
IAC	Illinois Administrative Code
IEMA	Illinois Emergency Management Agency
IES	Integrated Environmental Services
Illinois EPA	Illinois Environmental Protection Agency
ISGS	Illinois State Geological Survey
LUST	Leaking Underground Storage Tank
MBRG	Municipal Brownfield Redevelopment Grant
MSL	Mean Sea Level
NFR	No Further Remediation
PCB	Polychlorinated Biphenyl
PCE	Tetrachloroethene
Property	1020 Dixie Highway, Chicago Heights, Illinois
RA	Remedial Action
RACR	Remedial Action Completion Report
RAP	Remedial Action Plan

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RLF	Revolving Loan Fund
RO	Remediation Objective
ROR	Remedial Objectives Report
SIR	Site Investigation Report
SRP	Site Remediation Program
SSCBC	South Suburban Chicago Brownfield Coalition
SSL	Soil Saturation Limit
SSMMA	South Suburban Mayors and Managers Association
STL	Severn Trent Laboratories
SVOC	Semi-volatile Organic Compound
TACO	Tiered Approach to Corrective Action Objectives
TCE	Trichloroethene
TCLP	Toxicity Characteristic Leaching Potential
TOC	Total Organic Carbon
URS	URS Corporation
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UST	Underground Storage Tank
VOCs	Volatile Organic Compounds

EXECUTIVE SUMMARY

URS Corporation (URS) was retained by the City of Chicago Heights through the South Suburban Chicago Brownfields Coalition (SSCBC) under an Illinois Environmental Protection Agency (Illinois EPA) Municipal Brownfields Redevelopment Grant (MBRG) to provide environmental services for an 11.56-acre parcel of vacant land, known as the former Bloom Plaza property. A loan from the South Suburban Mayors and Managers Association's (SSMMA) United States Environmental Protection Agency (USEPA) Brownfields Revolving Loan Fund (RLF) was used to fund the remediation. The parcel (Property) is located at 1020 Dixie Highway in Chicago Heights, Illinois. A site location map and site map are provided as **Figure 1-1** and **Figure 1-2**, respectively.

This Remedial Action Completion Report (RACR) is intended to meet the requirements of the Illinois EPA's voluntary Site Remediation Program (SRP) as necessary to receive a focused No Further Remediation (NFR) letter for volatile organic compounds (VOCs) for the Property.

The Site Investigation Report/Remedial Objectives Report/Remedial Action Plan (SIR/ROR/RAP) was conditionally approved in the September 2, 2005 Illinois EPA letter. The approval was based on additional work required during the removal action, and included: 1) the removal of soil impacted with VOCs above soil saturation limits (SSLs), 2) the collection of confirmation samples, and 3) a slug test of existing monitoring well B-3 to determine the horizontal hydraulic conductivity of the shallow aquifer at the Property.

URS completed pre-remediation activities in November 2006. The pre-remediation activities included the advancement of four soil borings to confirm current conditions at the Property, the collection of soil physical parameters and the collection of waste characterization data. The remedial action was completed in May and June 2007 which included the removal of approximately 250 cubic yards of soil, the collection of eleven confirmation samples, and the placement of clean backfill. The soil was removed and transported offsite and disposed of at CID Landfill of Calumet City, Illinois as hazardous waste.

A Class II groundwater demonstration was completed for the Property based on the results of the slug test and boring logs in accordance with requirements established in 35 Illinois Administrative Code (IAC) 620.210. Therefore, for Tier 1 screening purposes, groundwater concentrations were compared to applicable Tiered Approach to Corrective Action Objectives (TACO) Class II groundwater standards.

Post remediation levels of tetrachloroethene (PCE) remain above soil migration to Class II groundwater remediation objectives (ROs) in confirmation soil samples Exv-1rev, Exv-2rev,

Exv-3-rev, Exv-4 and Exv-bottom. In addition, concentrations of PCE remained above industrial/commercial ROs for the inhalation pathway in samples Exv-2-rev and Exv-bottom and above construction worker ROs for the inhalation pathway in sample Exv-bottom. Confirmation soil sample Exv-bottom had levels of trichloroethene (TCE) above industrial/commercial ROs for the inhalation pathway and soil migration to Class II groundwater ROs.

A TACO Tier 2 evaluation was performed for the elevated concentrations of PCE and TCE that remained in soil post remediation. The Tier 2 evaluation incorporates the site-specific soil physical and hydrogeological data and was performed in accordance with Subpart G of 35 IAC 742. The site concentrations were compared to the calculated Tier 2 soil migration to groundwater ROs. No exceedances were found, which indicates that the residual PCE and TCE levels in soil would not adversely impact the offsite groundwater and therefore would not warrant any further evaluations.

An engineered barrier will be used to address the soil that exceeds the Tier 1 ROs for industrial/commercial properties. The engineered barrier will be used to exclude the soil ingestion, and inhalation routes. A Health and Safety Plan (HASP) will be used to address the soil that exceeds the Tier 1 ROs for construction workers. **Figure 6-1** presents the extent of the engineered barrier.

The key elements of the focused NFR letter for the Property are as follows:

- The Property will only be used for industrial/commercial purposes.
- Use of groundwater for drinking water purposes will be prohibited at the Property through a groundwater ordinance in order to limit potential future exposure to on-site groundwater through the groundwater ingestion route.
- Any future intrusive construction work (e.g., excavation into shallow soils at the Property) will require the implementation of the HASP, which adequately protects construction workers from exposure to potentially PCE-impacted shallow soil.
- An engineered barrier will be constructed and maintained. The purpose of the engineered barrier is to eliminate potential exposure of future industrial/commercial workers to the remaining localized areas of chlorinated solvent impacted soil.

The NFR letter will be recorded upon the deed with the Cook County Recorder of Deeds within 45 days of the City of Chicago Heights receipt of the letter from the Illinois EPA.

URS formally requests that the Illinois EPA approve this RACR and issue a focused NFR letter for VOCs to the City of Chicago Heights for this Property.

1.0 INTRODUCTION

URS Corporation (URS) was retained by the City of Chicago Heights through the South Suburban Chicago Brownfields Coalition (SSCBC) under an Illinois Environmental Protection Agency (Illinois EPA) Municipal Brownfields Redevelopment Grant (MBRG) to provide environmental services for an 11.56-acre parcel of vacant land, known as the former Bloom Plaza property. A loan from the South Suburban Mayors and Managers Association's (SSMMA) United States Environmental Protection Agency (USEPA) Brownfields Revolving Loan Fund (RLF) was used to fund the remediation. The parcel (Property) is located at 1020 Dixie Highway in Chicago Heights, Illinois. A site location map and site map are provided as **Figure 1-1** and **Figure 1-2**, respectively.

This Remedial Action Completion Report (RACR) is intended to meet the requirements of the Illinois EPA's voluntary Site Remediation Program (SRP) as necessary to receive a focused No Further Remediation (NFR) letter for volatile organic compounds (VOCs) for the Property.

1.1 Site Investigation Background

A Phase I Environmental Site Assessment (ESA) was performed in August of 2003 (URS, 2003). The Phase I ESA revealed that at one time the Property had a total of twelve underground storage tanks (USTs). The USTs were removed by Integrated Environmental Services (IES) in 1998. During the UST removals free product was observed and the site was assigned Leaking Underground Storage Tank (LUST) incident #982747 by the Illinois Emergency Management Agency (IEMA). Petroleum impacted soil surrounding eleven of the USTs was remediated. One of the confirmation soil samples collected during tank removals exceeded the Tiered Approach to Corrective Action Objectives (TACO) Tier 1 remediation objectives (ROs) for benzene and naphthalene.

The twelfth UST, which was associated with a dry cleaner, was removed; however, the impacted soil associated with this UST was not remediated. Soil samples collected from near the UST indicated the presence of tetrachloroethene (PCE), trichloroethene (TCE), and cis-1,2-dichloroethene (DCE) exceeding their TACO Tier 1 ROs. In addition, some of the soil samples exceeded the default soil saturation limit (SSL).

A Supplemental Site Investigation was performed by URS on June 2 and July 12, 2004 to define the extent of contamination from the dry cleaning UST (the twelfth UST). The supplemental site investigation involved the advancement of eight borings and the submittal of eight soil and three groundwater samples from the borings for laboratory analysis. Results of the investigation found methylene chloride and PCE in one sample (B-5) at concentrations

exceeding the TACO Tier 1 ROs for the soil migration to groundwater pathway. In addition PCE exceeded the Tier 1 RO for Class I groundwater in monitoring well MW-3.

The field investigation and laboratory analytical procedures were identified and Tier 1 RO exceedances were addressed in the focused Site Investigation Report/Remedial Objectives Report/Remedial Action Plan (SIR/ROR/RAP) (URS, 2005). The SIR/ROR/RAP included a Tier 2 evaluation for the groundwater ingestion exposure route in accordance with TACO. Migration and dilution models were used for the Tier 2 groundwater evaluation. The results indicated that the elevated PCE concentration in on-site groundwater would not adversely impact the offsite groundwater quality. The implementation of a groundwater use restriction at the Site was recommended to control the exposure to PCE in on-site groundwater. Subsequent to the recommendation, a local ordinance was passed restricting groundwater use in Chicago Heights.

1.2 Overall Scope of Work for Remedial Action

The scope of work, as established in the focused SIR/ROR/RAP and the conditional approval from the Illinois EPA on September 2, 2005, included the following specific tasks:

- Advancement of four borings and the collection of four soil samples to determine current concentrations of VOCs in the area of the dry cleaner tank excavation;
- Collection of one soil sample for soil physical parameters in order to calculate site specific SSLs, according to TACO;
- Collection of waste characterization samples to determine the proper disposal of the excavated material;
- Excavation and disposal of soil above site specific SSLs; and
- Collection of confirmation samples to verify that the soil exceedances present in surface soils at the impacted area have been removed.

In addition a groundwater classification was determined based partially on the results of a slug test performed on an existing well.

2.0 SITE BACKGROUND

2.1 Site Description and Background

No structures are present on the 11.56-acre vacant parcel. The western portion of the Property is asphalt paved. White painted lines were observed on the asphalt pavement, which indicates this area was used for car parking at one time. The northwestern boundary of the Property is heavily covered with grass and trees, and is fenced. The Property's western boundary was wood/wire-fenced. The Property is mostly flat, but higher than the neighboring areas on the north and west. A concrete foundation from the former building remains on the western portion of the Property. Cracks were observed throughout the asphalt pavement and concrete foundation through which grasses and weeds had grown. Fragments of structure supports and three asphalt patches atop the foundation were observed. Several grassy areas are present along the concrete foundation's north side where UST tanks were formerly located. The USTs were removed in 1999 and the areas were back-filled with soil.

No visual evidence of contamination such as piles of waste, abandoned materials, or transformers were present at the Property.

Storm-water drains were observed on the Property's eastern boundary in the road.

The history of the Property was established through interviews with personnel at the City of Chicago Heights and City of Chicago Heights Fire Department, aerial photographs, and fire insurance maps.

The Property is currently owned by the City of Chicago Heights. Historically, the Property had been used as farmland (see Phase I (URS, 2003)). Since the late 1950s or early 1960s, the Property was used as a shopping plaza. It was first named as Wallace Town Development and changed to Bloom Plaza and then to Trojan Place. The Property had been occupied by various retail stores, including a Jewel Tea Company store, an Osco Drug store, a carpet retail store, a billiard store, a dry cleaning business and other retail shops until the mid 1990s. In 1997 the Property was deeded to the City of Chicago Heights. The plaza building was demolished in 1999.

2.1.1 Site Location

The Property is located southwest of the intersection of Dixie Highway and 10th Street in the City of Chicago Heights, Cook County, Illinois. The Property is located in the Northeast Quarter of Section 21, Township 35 North, Range 14 East, of the Third Principal Meridian as shown on **Figure 1-1**, Site Location Map. The Site Location Map was extracted from the

1993 Harvey, IL United States Geological Survey (USGS) 7.5 Minute Series Quadrangle Map.

The Property is adjacent to commercial buildings on three sides and by residences on the west. **Figure 1-2** presents the site vicinity and neighboring properties. The Property is bounded by the following:

Northwest: Executive Plaza (1010 Dixie Highway);

Northeast: Skyline Restaurant (1016 Dixie Highway);

East: Dixie Highway, followed by Bloom High School (101 W. 10th St.) and a church;

South: Bank Calumet and parking lot (1030 Dixie Highway); and

West: Residences.

2.1.2 Environmental Setting

This section discusses the geology and soils; groundwater; and the floodplain and surface water in the vicinity of the site.

2.1.2.1 Geology

The Property is located in the southeast portion of Cook County, Illinois. The surficial geologic deposits in this section of the county are typically glacial drift deposited during the Wisconsinian Glacial Age. The topography in the vicinity of the Property and surrounding area is generally flat. According to the topographic map, the Property is at an approximate elevation of 640 feet above mean sea level (MSL).

According to the Illinois State Geological Survey (ISGS), Surficial Geology of the Chicago Region (1970), the surficial geology in the area is identified as the Lake Plain Formation. This formation mostly consists of floors of glacial lakes flattened by wave erosion and by minor deposition in low areas. It is largely underlain by glacial till. Thin deposits of silt, clay, and sand of the Equality Formation are present locally.

Review of the United States Department of Agriculture's (USDA) Soil Survey of DuPage and Parts of Cook Counties, Illinois (1979) revealed that the surface soils at the subject Property are classified as belonging to the Urban Land-Markham-Ashkum Association. This association consists of built-up areas and deep, gently rolling to nearly level, moderately well drained and poorly drained soils that have a clayey and silty subsoil and are formed in glacial till. Specifically, the on-site soils are categorized as Urban Land. This map unit consists of land covered by pavement and buildings. Urban Land is so modified by cuts and fills for works and structures that identification of the native soil is not feasible.

2.1.2.2 Hydrogeology

Groundwater flow generally parallels areas of higher surface elevation to lower elevations and toward the nearest surface water body. In general, the most likely flow direction for groundwater underlying the Property is expected to be toward a tributary of Thorn Creek, which is located approximately 1,000 feet southeast of the Property. Depth to groundwater was measured and groundwater elevations were calculated during the supplemental site investigation in 2004. Groundwater flow direction was calculated to be southwest. A groundwater flow map is presented as **Figure 2-1**.

Storm water drains were observed in the alley at the west side of the Property. Surface water on the Property flows toward the alley west of the Property which discharges to the City of Chicago Heights storm sewer system.

Potable water at the property is provided by the City of Chicago Heights, which purchases water obtained from Lake Michigan. Groundwater is not utilized for drinking purposes by populations in Chicago Heights.

There are no potable wells identified within a 1000-foot radius of the Property according to the following agencies:

- Illinois State Geological Survey (included in the Environmental Data Resources, Inc. (EDR) database search)
- Illinois State Water Survey (included in the EDR database search)
- Illinois Department of Public Health (Mr. Dave Rohbock of Cook County Department of Public Health)
- County and Municipal Health Departments (Mr. Dave Rohbock of Cook County Department of Public Health)
- City of Chicago Heights (Mr. Al Marconi).

A water well survey is presented as **Appendix E**.

A map showing the location of the water wells identified by the water well survey is presented in **Figure 2-2**. All of the identified potable wells are further than 1,000 ft from the site. In addition, Mr. Marconi indicated that the City of Chicago Heights capped all of their potable wells when they began purchasing water from the City of Hammond.

A Class II groundwater demonstration was completed for the Property based on the requirements established in 35 Illinois Administrative Code (IAC) 620.210. A class II groundwater classification is proposed based on the following information:

- Groundwater is located less than 10 feet below the land surface;

- The Property falls outside the minimum setback zone of a well which serves as a potable water supply;
- There is no area containing five feet of unconsolidated sand, gravel, or sand and gravel which is comprised of 12 percent or less of fines at the Property;
- There is no sandstone or fractured carbonate at the Property; and
- A slug test conducted at monitoring well B-3 produced a hydraulic conductivity of 5.8×10^{-6} cm/sec (presented in **Section 4.3**).

Therefore, for Tier 1 screening purposes, groundwater concentrations were compared to applicable TACO Class II groundwater standards.

3.0 REMEDIAL ACTION

Pre-remedial action samples were collected from the site in November 2006. This sampling event included four borings to confirm the current conditions at the site, the collection of soil physical parameters to determine site-specific SSLs and the collection of waste characterization samples for disposal purposes. The remedial action (RA) was completed in May and June 2007 and consisted of the excavation of soil above site SSLs for VOCs, the collection of soil confirmation samples and a slug test to determine the hydraulic conductivity at the site. A photolog of activities is presented in **Appendix A**. Laboratory analytical reports are presented in **Appendix B**.

3.1 Pre – Remediation Samples

Pre-remediation samples were collected on November 3, 2006. An overview of sample locations is presented in **Figure 3-1**.

3.1.1 Confirm Current Conditions

Four borings were performed to determine current concentrations of chemicals of concern (COCs) in the area of the dry cleaner tank excavation. Samples were collected from previous locations that exceeded Tier 1 ROs: T-9/B-1, T-9/SW-1, T-9/SW-3, and T-9/SW-4. Samples were screened in accordance with the Supplemental Site Investigation Workplan (URS, 2004). Samples were collected from the borings based on the prioritized criteria presented in Section 5.3.4 of the Workplan.

3.1.2 Soil Physical Parameters

Soil physical parameters were collected on November 3, 2006 from location B-8 to calculate site specific SSL, according to TACO.

A shelly tube from non-impacted and non-disturbed soil was collected for analysis of physical parameters for each type of soil lithology encountered above the water table. The soil type was determined using the procedure outlined in the Standard Practice for Description and Identification of Soils (Visual-Manual Procedure), ASTM D-2488-84. The physical parameters included:

- Air-filled porosity,
- Water-filled porosity,
- Soil bulk density,

- Total organic carbon (TOC), and
- pH.

Soil porosity and bulk density were analyzed by URS' laboratory in Totowa, New Jersey. TOC and pH were analyzed by STL of University Park, IL. To confirm that the soil sample was collected in an uncontaminated area of the Property the soil sample was also analyzed for VOCs, and semi-volatile organic compounds (SVOCs) by STL of University Park, Illinois.

3.1.3 Waste Characterization Samples

A sample was analyzed for Waste Characterization Target Compounds including the following:

- TCLP
 - VOCs,
 - SVOCs,
 - Metals,
 - Herbicides,
 - and Pesticides
- Polychlorinated biphenyls (PCBs)
- Ignitability
- Cyanide, Reactive
- Sulfide, Reactive
- Paint Filters Liquid Test and Corrositivity

One grab sample was submitted for VOC analysis. A composite sample was collected from all of the pre-remediation soil sample locations.

3.2 Soil Excavation

Soil was excavated by RW Collins under the supervision of URS field personnel May 3 and 4, 2007. Based on confirmation sample results, a follow up excavation was completed May 14, 2007. An overview of the excavated area is presented as **Figure 3-2**. As the figure illustrates, the excavation is L-shaped and is approximately 41 feet by 45 feet. The soil was excavated to groundwater table (approximately 6ft).

Approximately 250 cubic yards of soil were removed and transported offsite and disposed of at CID Landfill of Calumet City, Illinois as hazardous waste because the soil contained a F-

listed waste. The excavated soil was replaced with clean backfill. Manifests for the disposal of the soil are presented in **Appendix F**.

3.3 Confirmation Sampling Plan

Soil samples were collected from the excavation in accordance with procedures described in the focused SIR/ROR/RAP (URS, 2005). Upon completion of excavation activities one sample was collected from each wall and one sample was collected from the floor of the excavation.

Confirmation samples were collected using stainless steel sampling equipment such as spoons, trowels, spatulas, or knives. Due to safety concerns, samples from the excavation were collected with the assistance of a backhoe. Soil was collected from a depth of zero to six inches below the excavation floor by the backhoe and the sample was collected from the backhoe bucket and transferred into laboratory supplied containers. Care was taken to ensure that the sample came from soil that did not come in direct contact with the backhoe bucket. Chain-of-custody records were maintained to document sample collection times, dates, and analyses.

A total of eight confirmation samples were collected from the excavation as presented in **Figure 3-2**.

The soil samples were delivered on ice under proper chain-of-custody procedures to STL.

3.4 Slug Testing

Existing monitoring well B-3 was slug tested on June 4, 2007 to determine the estimated hydraulic conductivity (K_h) of the shallow aquifer at the Property. The hydraulic conductivity was estimated using a falling-head test. The procedure for the testing was as follows:

1. Static water levels were recorded prior to the set up of the slug test.
2. Water was inserted into the well casing.
3. Water levels were manually recorded with a water level indicator every 15 seconds for 5 minutes, every minute for 30 minutes, followed by every 5 minutes for one hour, then every 15 minutes for 7 hours.

Slug test response data from monitoring well B-3 was manually recorded with a water level indicator. Data was converted to lapsed time and visually inspected to determine if the response data was valid before loading it into AQTESOLV (Version 4.01) pumping and slug

tests data analysis software. The Bower and Rice (BR) (Bower and Rice, 1976) and Cooper, Bredhoeft, and Papadopoulos (CBP) methods were used to analyze the data.

4.0 SOIL AND GROUNDWATER SAMPLING RESULTS

4.1 Pre-Remediation Samples

Results of the pre-remediation sampling are summarized in **Tables 4-1** and **4-2**.

4.1.1 Confirm Current Conditions

A total of eleven soil samples were collected and analyzed for VOCs. **Table 4-1** provides a summary of the results compared to TACO Tier 1 ROs for industrial/commercial properties. As the table shows, PCE concentrations were present at levels above TACO Tier 1 ROs for industrial/commercial properties in all but one pre-remediation sample. The PCE impacts were encountered in both shallow and deep soil samples. In addition to PCE, TCE was encountered at levels above TACO Tier 1 ROs for industrial/commercial properties in five soil samples. Pre-remediation sample B1 (20-24 ft) also had naphthalene and vinyl chloride at levels above TACO Tier 1 ROs for industrial/commercial properties. Concentrations of chlorinated solvents were present at levels comparable to the November 1998 results.

4.1.2 Soil Physical Parameters

Soil sample B-8 was analyzed for soil physical parameters. **Table 4-2** provides a summary of the results. Soil sample B-8 was also analyzed for VOC and SVOC concentrations (see **Table 4-1** and **4-3**, respectively). No VOC or SVOC constituents were identified in this background sample.

4.1.3 Calculation of Site-specific Soil Saturation Limits

Soil physical parameters were collected to calculate site specific soil saturation limits in accordance with TACO (see **Section 3.1.2**). The calculated site-specific SSLs were below the default SSLs; therefore, the default SSLs were used for determining excavation limits.

4.2 Soil Confirmation Sampling Results

Soil samples were collected from the excavation in accordance with procedures described in the focused SIR/ROR/RAP (URS, 2005). Upon completion of excavation activities one sample was collected from each wall and floor. Confirmation samples were compared to Illinois EPA TACO industrial/commercial and construction worker ROs and soil migration to Class II groundwater ROs. Results of the confirmation sampling are summarized in **Table 4-4**. As the table shows, confirmation samples were collected along the north, east, and west walls of the excavation May 3 and 4, 2007. PCE concentrations in these samples were above

the default SSL and excavations continued in these areas. A second round of confirmation samples were collected from the north, east, and west walls on May 14, 2007. Soil confirmation results indicated all levels of PCE were below the default SSL.

Figure 4-1 summarizes TACO Tier 1 RO Exceedances that remain in the soil after the completion of the remedial action. As the figure illustrates, PCE concentrations remain above soil migration to Class II groundwater ROs in confirmation soil sample Exv-1rev, Exv-2-rev, Exv-3-rev, Exv-4 and Exv-bottom. In addition, concentrations of PCE are above industrial/commercial ROs for the inhalation pathway in samples Exv-2-rev and Exv-bottom and above construction worker ROs for the inhalation pathway in sample Exv-bottom. Confirmation soil sample Exv-bottom has levels of TCE above industrial/commercial ROs for the inhalation pathway and soil migration to Class II groundwater ROs.

4.3 Hydraulic Conductivity Calculations

Hydraulic conductivity calculations were determined using the BR (Bouwer and Rice, 1976) and CBP (Cooper et al., 1967; Papadopoulos et al., 1973) methods. The range in calculated hydraulic conductivity is:

- BR Method – 5.8×10^{-6} centimeter/second (cm/s)
- CBP Method – 2.0×10^{-7} cm/s

Documentation of slug test data analyses using the AQTESOLV software can be found in **Appendix C**. The conservative value of 5.8×10^{-6} cm/s was used in TACO Tier 2 evaluations.

5.0 EVALUATION OF SOIL AND GROUNDWATER RESULTS

5.1 Summary of Tier 1 Evaluation of Pre-Remediation and Confirmation Results

PCE concentrations remain above soil migration to Class II groundwater ROs in confirmation soil sample Exv-1rev, Exv-2-rev, Exv-3-rev, Exv-4 and Exv-bottom. In addition, concentrations of PCE are above industrial/commercial ROs for the inhalation pathway in samples Exv-2-rev and Exv-bottom, and above construction worker ROs for the inhalation pathway in sample Exv-bottom. Confirmation soil sample Exv-bottom has levels of TCE above industrial/commercial ROs for the inhalation pathway and soil migration to Class II groundwater ROs.

5.2 Tier 2 Evaluation for Soil Component of Groundwater Ingestion Route

A TACO Tier 2 evaluation was performed for the elevated constituent concentrations that remain in soil at the site after remediation. The Tier 2 evaluation incorporates the site-specific soil physical and hydrogeological data and was performed in accordance with Subpart G of 35 IAC 742.

The purpose of the Tier 2 evaluation is to address the elevated concentrations of COCs identified through a TACO Tier 1 screening presented above. Based on the Tier 1 screening results, the only issue which needs to be addressed in the Tier 2 evaluation is:

- Elevated PCE and TCE concentrations which were found in several confirmation soil samples at concentrations exceeding the Tier 1 soil migration to Class II groundwater ROs.

Tier 2 fate and transport modeling was performed to establish site-specific Tier 2 soil migration to groundwater ROs for these two COCs.

The Tier 2 evaluation is a two-step modeling, incorporating site-specific soil physical and hydrogeological parameters. The objective is to back calculate the maximum allowable COC concentrations in soil (considering leaching to groundwater) that would not result in Class I Groundwater RO exceedances at the down-gradient property boundary. Although the site groundwater is Class II, a comparison to Class I ROs at the property boundary is required since the property owner has no control over adjacent property owners, and no specific information determining groundwater classification on the adjacent property is available.

The Tier 2 modeling included the following two steps:

- Soil leaching modeling using TACO Equations R12 and R14 to estimate the allowable residual soil concentration at the source location based on the soil leachate concentration, and
- Groundwater migration modeling using TACO Equation R26 to back-calculate the allowable groundwater concentration at the source that would not migrate to the down-gradient property boundary at levels above Class I groundwater ROs.

The groundwater migration modeling result is dependent on the distance between the source and the down-gradient property boundary. To be conservative, the Tier 2 RO was calculated for all COCs based on the shortest distance (150 ft) between the source area and the downgradient property boundary, which represented the worst-case scenario for the site.

5.2.1 Soil Leaching Modeling

The key site-specific soil physical parameter values applied to the Tier 2 soil leaching modeling include total organic carbon (f_{oc}), dry bulk density (ρ_s), and air-filled soil porosity (θ_{as}) and water-filled soil porosity (θ_{ws}). The site-specific values of these parameters are presented in **Tables 5-1**. The key site-specific hydrogeological parameters included groundwater gradient (i) and hydraulic conductivity (K), and their values were discussed in the following sections.

The soil leaching modeling is presented in **Table 5-1**.

5.2.2 Groundwater Migration Modeling

The soil leachate concentration at the source used in the leaching model was based on the result of the groundwater migration modeling. The objective of the groundwater migration modeling is to estimate the source concentration (C_{source}) based on the target groundwater concentration at the down-gradient property boundary. The C_{source} was subsequently used as the soil leachate concentration in the leaching model.

The site-specific parameters incorporated in the groundwater migration modeling are the target concentration at the down-gradient property boundary ($C_{(x)}$), source width (S_w), groundwater gradient (i), hydraulic conductivity (K), and distance from source to the down-gradient property boundary. The TACO default values were used when site-specific information was not available. Each site-specific parameter is discussed below:

- The target groundwater concentration at the down-gradient property boundary, $C_{(x)}$, was the TACO Tier 1 soil component of groundwater ingestion RO for Class I groundwater, which was obtained from TACO, Appendix B Table F.
- Source width, S_w , was estimated to be less than 100 ft based on the dimensions of the biggest source area at the site (see the excavation area on **Figure 3-2**).

- The overall groundwater gradient for the near surface aquifer, i , was estimated to be 0.005 cm/cm to the southwest based on the groundwater elevation measurements and the Groundwater Contour Map presented in the Focused Site Investigation Report (URS, 2005).
- The hydraulic conductivity, K , ranged from 2.0×10^{-7} to 5.8×10^{-6} cm/sec based on the slug test results presented in **Section 4.3**. The maximum value of 5.8×10^{-6} cm/sec was used in the modeling.
- The total porosity value of 0.33 is based on the site-specific measurement.
- The nearest source to the down-gradient property boundary (southwestern boundaries) is the excavation area shown on **Figure 3-2**, which is approximately 150 feet from the downgradient boundaries. To be conservative, this distance was used as the distance parameter, X , in the modeling for all COCs modeled.

Table 5-2 summarizes parameters required in Equation R26, including TACO default values and site-specific values.

A simulation of potential migration of COCs from the source locations to the down-gradient property boundary is presented in **Table 5-3**. **Table 5-4** summarizes the back-calculated groundwater concentrations at the source and final soil migration to groundwater ROs.

5.2.3 Uncertainty

The Tier 2 modeling for the soil migration to groundwater exposure route presented above is based on the following conservative assumptions:

- The leaching modeling was performed without considering the potential effect of the existing asphalt cover on top of the residual elevated concentrations.
- The on-site groundwater encountered at the site is laterally continuous. It was assumed to consist of a homogenous aquifer, with the direct hydraulic connection with potential down-gradient receptors. However, the on-site geology consists of mostly clayey and silty clayey soil, with perched and discontinuous shallow groundwater.

Therefore, the results of the Tier 2 modeling may involve significant uncertainties and likely overestimates the potential impact of soil leaching and down-gradient migration capacities.

5.2.4 Comparison of Tier 2 Soil Migration to Groundwater ROs with Site Concentrations

The site concentrations were compared to the calculated Tier 2 soil migration to groundwater ROs. No exceedances were found, which indicates that the residual PCE and TCE levels in soil would not adversely impact the offsite groundwater and therefore would not warrant any further evaluations.

6.0 ENGINEERED BARRIERS AND INSTITUTIONAL CONTROLS

6.1 Engineered Barrier

An engineered barrier will be used to address the soil that exceeds the Tier 1 ROs. The engineered barrier will be used to exclude the soil ingestion, and inhalation routes. **Figure 6-1** presents the extent of the engineered barrier.

6.2 Institutional Controls

Types of institutional controls recognized under TACO include NFR Letters, Environmental Land Use Controls (ELUCs), Ordinances administered by a unit of local government, and Highway Authority Agreements (HAA). Institutional controls are required in accordance with 35 IAC 742.1000 when remediation objectives are based on any of the following:

- Industrial/commercial land use;
- Target cancer risk greater than 1 in 1,000,000;
- Target Hazard Quotient greater than 1;
- Engineered barriers;
- The point of human exposure is located at a place other than at the source;
- Exclusion of exposure routes; or
- Any combination of the above.

Several conditions outlined above exist at the site. Institutional controls in accordance with 35 IAC 742.1000 that need to be applied at the subject site include industrial commercial land use, engineered barrier, and a groundwater ordinance.

6.2.1 Groundwater Ordinance

The City of Chicago Heights has a groundwater ordinance in place to restrict the use of groundwater (see **Appendix D**). The groundwater ordinance will be used as an institutional control to restrict groundwater use for drinking purposes at the site.

6.2.2 NFR Letter

Pursuant to 35 IAC 742.1005, a NFR letter issued by the Illinois EPA under 35 IAC 740, i.e., SRP, can be used as an institutional control to impose land use limitations or requirements related to environmental impacts. The NFR letter will be recorded upon the property deed,

placing any future property owner on notice of the land use or activity restrictions required due to the property's environmental conditions.

The activities that would be limited or required in the NFR Letter for the Property include:

- The property will only be used for industrial/commercial purposes.
- Use of groundwater for drinking purposes will be prohibited at the Property to limit potential future exposure to on-site groundwater through the groundwater ingestion route through a groundwater ordinance.
- Any future intrusive construction work (excavation into shallow soils at the site) will require the implementation of the Health and Safety Plan (HASP), which adequately protects construction workers from exposure to potentially PCE-impacted shallow soil.
- The engineered barrier will be maintained. The purpose of the engineered barrier is to eliminate potential exposures of future industrial/commercial workers to the remaining localized areas of chlorinated solvent impacted soil.

The NFR letter will be recorded on the deed with the Cook County Recorder of Deeds within 45 days of the City of Chicago Heights receipt of the letter from the Illinois EPA.

7.0 REFERENCES

- Bouwer, H., 1989. The Bouwer and Rice Slug Test – An Update, *Ground Water*, Vol. 27, No. 3, pp. 304-409, May-June 1989.
- Cooper, H.H., Jr., J.D. Bredehoeft, and I.S. Papadopoulos, 1967. Response of a Finite Diameter Well to An Instantaneous Charge of Water, *Water Resources Research*, Vol. 3, No.1, pp. 263-269.
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- URS Corporation, 2003. Phase I Environmental Assessment Report, 1020 Dixie Highway, Chicago Heights, Illinois, August 2003.
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